PATENT ABSTRACTS OF JAPAN

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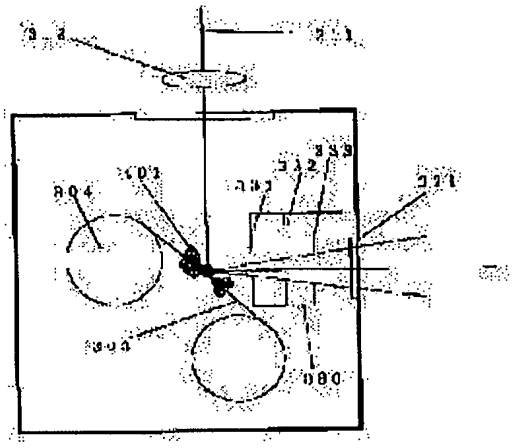
(71)Applicant : NIKON CORP
(72)Inventor : KAMITAKA NORIAKI
KONDO HIROYUKI

(54) X-RAY GENERATOR

(57)Abstract:
PURPOSE: To provide an X-ray generator having the capability of reducing the adhesion and deposition of undesirable scattered particles, and ensuring a stable service over a long time by laying a scattered particle stopping member at such a position as adjacent to or near a solid angle zone corresponding to a range for taking out an X-ray.
CONSTITUTION: A scattered particle stopping member 330 has three plates 331 to 333 having such apertures as not obstructing the optical path of an X-ray incident on a filter 321, and the plates 331 to 333 are separated from one another at the preset distance. The size of scattered particles generated from a Ta target 303 is at such a level as corresponding to ions and atoms. A distance from a plasma to the plate 331 is short, and the particles reach the plate 331 in such a state as almost free from the effect of buffer gases. Also, the release of the particles concentrates on the surface of a Ta tape in the direction of the normal line of the tape, but the particles in that direction are also stopped by the plate 331. The particles flowing through the aperture of the plate 331 progress in such a state as scattered due to the buffer gases, and begin to deviate from an initial progress direction. As a result, some particles even through the aperture of the plate 331 cannot pass the apertures of the plates 332 and 333.



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[Patent number]	3666055
[Date of registration]	15.04.2005
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[Date of extinction of right]	

CLAIMS

[Claim(s)]
[Claim 1] The X-ray generator characterized by to prepare the scattering particle inhibition member which adjoins or approaches in the solid angle field which is equivalent to the range which takes out said X-ray in the X-ray generator which uses a buffer gas in order to prevent the scattering particle which is the X-ray generator which irradiates an excitation energy beam at the target member in the decompressed vacuum housing, is made to form the plasma, and takes out an X-ray from this plasma, and is emitted from said target member and/or said plasma.
[Claim 2] The X-ray generator characterized by to prepare a scattering particle inhibition member in the solid angle field which is equivalent to the range which takes out said X-ray in the X-ray generator which uses a buffer gas in order to prevent the scattering particle which is the X-ray generator which irradiates an excitation energy beam at the target member in the decompressed vacuum housing, is made to form the plasma, and takes out an X-ray from this plasma, and is emitted from said target member and/or said plasma.
[Claim 3] The X-ray generator according to claim 1 or 2 characterized by preparing further the scattering particle control-section material which it is [material] the scattering particle control-section material which controls direction distribution of the burst size of the scattering particle emitted from said target member and/or said plasma, and reduces the burst size of the scattering particle to the direction which takes out said X-ray.
[Claim 4] The X-ray generator according to claim 1 to 3 characterized by establishing further a cooling means to cool said scattering particle inhibition member.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the X-ray generator used for X-ray plants, such as an X-ray aligner, an X-ray microscope, and an X-rays spectroscopic analyzer.
[0002]
[Description of the Prior Art] If the target member placed into the vacuum housing which had laser light (an example of an excitation energy beam) decompressed is condensed and irradiated, a target member is plasma-ized quickly and what an X-ray with very high brightness is radiated for from this plasma (an X-ray is generated) (emission) is known (for example, such an X-ray generation source is called LPX:Laser-Plasma X-raysource).
[0003] With generating of an X-ray, from said plasma, the scattering particles (for example, the gasified ingredient, the ionized ingredient, an ingredient wafer, etc.) of a member ingredient are emitted from said target member, and scattering particles, such as a high-speed electron and ion, disperse in a vacuum housing from it again (these are hereafter called a scattering particle collectively). What has a comparatively big configuration is called debris (debris) among these scattering particles. Since such a scattering particle (especially debris) collided with the clarification optical surface (for example, X-ray optics component side), adhered, was deposited, and the function and the property were reduced or it was changed [**** / damaging these], it was a big problem.
[0004] In order to solve this trouble, he was trying for a scattering particle not to arrive at a clarification optical surface by the conventional approach by installing and covering the thin film (it being hereafter called the thin film for scattering particle inhibition, or an X-ray ejection filter) which consists of roentgenoparent high matter (for example, Be) between X line source and a clarification optical surface, being filled up with the gas of the low atomic number with the high permeability to an X-ray (for example, helium gas) in a vacuum housing as the other approaches -- or by forming the gas stream of this gas, the gas molecule was made to collide with a scattering particle, and inhibition of a scattering particle was aimed at (refer to JP,63-292553,A).
[0005]
[Problem(s) to be Solved by the Invention] There is a trouble that the rate of radioparency of the thin film for scattering particle inhibition falls gradually by installation of the thin film for scattering particle inhibition since a scattering particle adheres and deposits on the thin film for scattering particle inhibition although adhesion of the scattering particle to a clarification optical surface and deposition can be prevented instead (the use X-ray intensity in the direction of X-ray ejection falls).
[0006] Moreover, by the approach of aiming at inhibition of a scattering particle, there is a trouble that a scattering particle cannot necessarily be prevented effectively, by [which are filled up with the gas of a low atomic number with the high transmission to an X-ray (buffer gas) in a vacuum housing] depending especially or forming the gas stream of this gas. For example, when a target member is a tantalum, within the fully exhausted vacuum housing (pressure of 10Pa or less), many scattering particles in the direction of a normal of a target member front face are distributed. And although a scattering particle will decrease about the direction where many scattering particles are emitted for dispersion by the gas molecule if the buffer gas for scattering particle inhibition is introduced in a vacuum housing, the scattered scattering particles disperse before gas installation also in the direction which had little emission of a scattering particle.
[0007] Therefore, if a buffer gas is used in order to prevent a scattering particle, distribution of the emission direction of a scattering particle will be equalized. About the direction with little emission of a scattering particle, as compared with the direction with much emission of a scattering particle, this has the small effectiveness of gas installation, or shows that it becomes an opposite effect rather. As for the ejection of an X-ray, it is common to carry out in a direction with little emission of a scattering particle, and the effectiveness of gas installation is small about the direction of ejection of an X-ray with little emission of a scattering particle, or it is a big trouble to become an opposite effect rather.
[0008] When preparing the scattering particle control-section material which it is [material] the scattering particle control-section material which controls direction distribution of the burst size of a scattering particle near the plasma especially, and reduces the burst size of the scattering particle to the direction which takes out said X-ray, the effectiveness of the gas installation about the direction of ejection of an X-ray is small, or it is a big trouble to become an opposite effect rather. This invention is an X-ray generator which uses a buffer gas, in order to have been made in view of this trouble and to prevent a scattering particle, and it aims at offering the X-ray generator which can use about the direction of ejection of an X-ray, reducing adhesion of an inconvenient scattering particle and deposition, consequently carrying out long duration stability.
[0009]
[Means for Solving the Problem] Irradiate an excitation energy beam at the target member in the decompressed vacuum housing, and the plasma is made to form. therefore, this invention -- the first -- "-- In the X-ray generator which uses a buffer gas in order to prevent the scattering particle which is the X-ray generator which takes out an X-ray from this plasma, and is emitted from said target member and/or said plasma The X-ray generator (claim 1) characterized by preparing the scattering particle inhibition member which adjoins or approaches in the solid angle field equivalent to the range which takes out said X-ray" is

offered.
[0010] Moreover, this invention provides the second with "the X-ray generator (claim 2) characterized by to prepare a scattering particle inhibition member in the solid angle field which is equivalent to the range which takes out said X-ray in the X-ray generator which uses a buffer gas in order to prevent the scattering particle which is the X-ray generator which irradiates an excitation energy beam at the target member in the decompressed vacuum housing, is made to form the plasma, and takes out an X-ray from this plasma, and is emitted from said target member and/or said plasma."
[0011] Moreover, this invention provides the third with "the X-ray generator (claim 3) according to claim 1 or 2 characterized by preparing further the scattering particle control-section material which it is [material] the scattering particle control-section material which controls direction distribution of the burst size of the scattering particle emitted from said target member and/or said plasma, and reduces the burst size of the scattering particle to the direction which takes out said X-ray."
[0012] Moreover, this invention provides the fourth with "the X-ray generator (claim 4) according to claim 1 to 3 characterized by establishing further a cooling means to cool said scattering particle inhibition member."
[0013]
[Function] Irradiate an excitation energy beam and the plasma is made to form in the target member in the decompressed vacuum housing. To the X-ray generator which uses a buffer gas in order to prevent the scattering particle which is the X-ray generator which takes out an X-ray from this plasma, and is emitted from said target member and/or said plasma If the scattering particle inhibition member located the outside (field which adjoins or approaches) or inside a solid angle field is prepared, [equivalent to the range which takes out an X-ray] Since adhesion of an inconvenient scattering particle and deposition (adhesion to the thin film for scattering particle inhibition, a clarification optical surface, etc., deposition) can be reduced about the direction of ejection of an X-ray consequently, long duration stability is carried out and an X-ray generator can be used (claims 1 and 2).
[0014] Like drawing 1 (a), the field 103 within the solid angle which expected opening 102 from the plasma 101 (solid angle field equivalent to the range which takes out an X-ray) is considered. Drawing 1 (b) shows the cross section containing the plasma and opening. In sufficient vacua, a scattering particle exercises linearly and the scattering particles 110 and 111 which carried out outgoing radiation into the solid angle field 103 (105) reach opening 102 only through the inside of a field 103 (105).
[0015] however, the particle 112 which advances into a field 103 (105) at first as a result of dispersion into the scattering particle which carried out outgoing radiation out of the field 103 (105) since a scattering particle will collide with a gas molecule and will be scattered about, if a buffer gas is introduced in a vacuum housing -- moreover, in the scattering particle which came out of the field 103 (105) once, the particle 113 which returns in a field 103 (105) again exists, respectively.
[0016] The scattering particle to which this reaches opening 102 shows from beginning to end that it does not necessarily pass through the inside of a field 103 (105) after generating until it reaches. On the other hand, the optical path of the X-ray generated from the plasma is a straight line, and the light of the X-ray which reaches opening 102 is always in a field 103 (105). Here, as shown in drawing 2 , the case where the member 201 (an example of a scattering particle inhibition member) with puncturing is formed is considered. Puncturing of a member is equal to the cutting plane of the solid angle field 103 (105).
[0017] There is no effect in the X-ray which reaches opening 102 even if it forms a member 201 in any way, and the amount of the X-ray taken out does not change. On the other hand, since said particles 112 and 113 which are going to advance into a field 103 (105) among scattering particles are prevented by the member 201, the scattering particle which reaches opening 102 decreases compared with the time of not forming a member 201.
[0018] It is not necessarily limited to a tabular object with puncturing like a member 201 that the scattering particle inhibition member which brings about such effectiveness should just have the configuration from which the scattering particle which came out of the field 103 (105) can prevent advancing into a field 103 (105) again. Moreover, although the amount of X linear lights taken out strictly will fall, the aforementioned effectiveness is acquired even if it prepares a scattering particle inhibition member in the solid angle field equivalent to the range which takes out an X-ray. For example, as shown in drawing 8 , it is the case where a very thin plate is formed in accordance with an optical path on the optical path of the X-ray in a solid angle field.
[0019] Thus, irradiate an excitation energy beam and the plasma is made to form in the target member in the decompressed vacuum housing. To the X-ray generator which uses a buffer gas in order to prevent the scattering particle which is the X-ray generator which takes out an X-ray from this plasma, and is emitted from said target member and/or said plasma If the scattering particle inhibition member located the outside (field which adjoins or approaches) or inside a solid angle field is prepared, [equivalent to the range which takes out an X-ray] Since adhesion of an inconvenient scattering particle and deposition (adhesion to the thin film for scattering particle inhibition, a clarification optical surface, etc., deposition) can be reduced about the direction of ejection of an X-ray consequently, long duration stability is carried out and an X-ray generator can be used (claims 1 and 2).
[0020] Moreover, if the scattering particle control-section material which it is [material] the scattering particle control-section material which controls direction distribution of the burst size of a scattering particle, and reduces the burst size of the scattering particle to the direction which takes out an X-ray is prepared further, since the scattering particle inhibition effectiveness in the direction of ejection of an X-ray will increase, it is desirable (claim 3). It is good to prepare the following configuration parts for example, in scattering particle control-section material by this scattering particle control-section material, in order to reduce the scattering particle burst size to the direction of X-ray ejection.
[0021] The through tube which has the maximum open aperture section whose aperture angle over the 0.1-3mm minimum opening diameter and this minimum opening diameter it is the through tube prepared in said scattering particle control-section material, and is 60 - 140 degrees as this configuration part, for example is desirable. Said minimum opening diameter is made to adjoin or approach the condensing part to said target member top of said excitation energy beam. If the ejection angle of said X-ray [as opposed to this condensing part for the include angle in which said excitation energy beam carries out incidence to said condensing part through said through tube] is set as 0 - 60 degrees again at 30 - 60 degrees, respectively Without decreasing the X-ray intensity to the direction of ejection, since adhesion of the inconvenient scattering particle to the direction of ejection and deposition can be reduced remarkably, it is desirable.

[0022] The configuration part which reduces the scattering particle burst size to the direction which takes out an X-ray When for example, said not only through tube prepared in scattering particle control-section material but scattering particle control-section material is constituted by two or more members It may be the gap of the shape of a taper which it comes to form between at least two members in these two or more members, and the gap of the shape of a taper which has the 0.1-3mm least interval section and the maximum gap section whose aperture angle over this least interval section is 60 - 140 degrees is sufficient.
[0023] The least interval section of the gap of the shape of this taper is made to adjoin or approach the condensing part to the target member top of an excitation energy beam. And if the ejection angle of an X-ray [as opposed to this condensing part for the include angle in which an excitation energy beam carries out incidence to said condensing part through a taper-like gap] is set as 0 - 60 degrees again at 30 - 60 degrees, respectively Without reducing the X-ray intensity to the direction of ejection, since adhesion of an inconvenient scattering particle and deposition can be reduced, it is desirable.
[0024] As an ingredient used for the scattering particle control-section material concerning this invention, high-melting [, such as a tantalum, a tungsten, a diamond, and a ceramic,] or the ingredient of a high degree of hardness is desirable, for example. Since scattering particle control-section material is arranged in the location which approached the plasma very much, this is for preventing emission of this member ingredient by the collision to this member front face of ion or an electron that comes flying from the plasma. That is, since inconvenient adhesion and deposition will arise like a scattering particle if there is emission of this member ingredient, this is prevented.
[0025] If a cooling means to cool said scattering particle inhibition member is established further, since this member will become easy to adsorb a scattering particle and the inhibition effectiveness will increase, it is desirable (claim 4). Or it is also desirable to process the front face of a scattering particle inhibition member (for example, delustering processing) so that it may be easy to adsorb a scattering particle. Hereafter, although an example explains this invention to a detail further, this invention is not limited to these examples.
[0026]
[Example] The outline block diagram of the X-ray generator of this example is shown in drawing 3 . Moreover, drawing 4 is the expanded sectional view of the tape presser-foot aperture 401 which is the scattering particle control-section material which controls direction distribution of a scattering particle burst size, and is an example of the scattering particle control-section material which reduces the burst size of the scattering particle to the direction which takes out an X-ray.
[0027] The angular distribution of the burst size of a scattering particle is controlled by this aperture 401, and turns into distribution concentrated in the direction of a normal of a tantalum tape front face. The angular distribution of a scattering particle burst size in case there is nothing with the case where there is an aperture 401 is shown in drawing 5 . The YAG laser light (an example of an excitation energy beam) 311 is condensed by the front face of the Ta target (an example of a target member) 303 with a condenser lens 312. The Ta target 303 is changing the laser condensing location at the time of plasma generating, rotating a reel 304 by the driving means (for example, a motor, un-illustrating), and rolling round Ta tape so that it may be a tape configuration with a thickness of 15 micrometers and laser light may not be condensed by the homotopic on a tape.
[0028] The passing speed of Ta tape is a rate which moves more than the diameter part of the hole which will be produced on Ta tape according to generating of the plasma by the time the laser light which one plasma is generated and generates the following plasma carries out incidence. The X-ray emitted from the generated plasma (radiation) passes the X-ray ejection filter (thin film for scattering particle inhibition) 321, and results in an X-ray optics system.
[0029] In this example, as the scattering particle inhibition member 330 is shown in drawing 3 , it has three plates 331, 332, and 333 which have puncturing which does not interrupt the optical path of the X-ray which carries out incidence to a filter 321, and each plate is isolated in a predetermined distance, respectively. Moreover, installation and exhaust air of helium are performed so that helium may be introduced as a buffer gas in the vacuum housing and the pressure may be held uniformly.
[0030] Since the Ta target 303 has the very high melting point, the scattering particle to generate is the magnitude of ion and atomic level. The angular distribution of a scattering particle burst size is as being shown in drawing 5 , and in this example, it makes the ejection include angle of an X-ray 45 degrees so that the scattering particle burst size in the direction of X-ray ejection may decrease. Since the distance from the plasma to a plate 331 is short, a scattering particle reaches a plate 331, without being influenced [most] of a buffer gas. That is, almost is prevented with a plate 331 except the scattering particle which jumped out in the direction of X-ray ejection first.
[0031] As shown in drawing 5 , emission of a scattering particle is concentrated in the direction of a normal of a tantalum tape front face, but since the scattering particle of this direction is also prevented with a plate 331, a filter 321 is not reached even if scattered about by the buffer gas. Moreover, since it progresses while the scattering particles which passed puncturing of a plate 331 are scattered about by the buffer gas, the locus is no longer a straight line, and it shifts from the first travelling direction as it faces to a filter 321.
[0032] Therefore, what cannot pass puncturing of a plate 332 or a plate 333 comes also out of the scattering particle which passed puncturing of a plate 331. Therefore, the scattering particle which finally reaches a filter 321 decreases considerably rather than the scattering particle first generated in the solid angle field equivalent to the range which takes out an X-ray. The configuration of the scattering particle inhibition member 330 is not limited to the example of drawing 3 , and it just prevents a scattering particle efficiently, without interrupting the optical path of the X-ray emitted in the direction of X-ray ejection.
[0033] For example, it is good also as a scattering particle inhibition member 341 of a truncated-cone configuration in the air as shown in drawing 6 . Or when alignment with a delicate scattering particle inhibition member is difficult, as shown in drawing 7 , it is good also as a scattering particle inhibition member 351 which consists of one plate, and the scattering particle which goes in the direction of X-ray ejection by dispersion from a direction with many scattering particles even in this case can be effectively prevented by the scattering particle inhibition member 351.
[0034] Moreover, although some will interrupt the optical path of the X-ray in the solid angle field equivalent to the range which takes out an X-ray, as shown in drawing 8 , it is also effective to install the scattering particle inhibition member 811 which

consists of two or more very thin plates in accordance with an optical path in X linear-light on the street. In this case, if that travelling direction changes by the buffer gas even when a scattering particle does not come out from a solid angle field, the scattering particle inhibition member 811 will be adsorbed.

[0035] When the scattering particle inhibition member 811 shown in drawing 8 is used and it will be aimed only at the total quantity of light of the time of performing Koehler illumination, or an X-ray although lighting nonuniformity occurs if critical illumination is performed, X dosage only falls very slightly and it is satisfactory practically (for example, instrument for analysis etc.). As for the scattering particle inhibition members 330, 341, 351, and 811, it is desirable to process a front face (for example, delustering processing) so that it may be easy to adsorb a scattering particle. Moreover, if a cooling means to cool the scattering particle inhibition members 330, 341, 351, and 811 is established further, since this member will become easy to adsorb a scattering particle and the inhibition effectiveness will increase, it is desirable.

[0036] In addition, the configuration of a target member may not be limited in the shape of a tape, and may have the shape of tabular or bulk. Moreover, the ingredient of a target member may not be limited to Ta, either and aluminum, Sn, Zn, Pb, etc. are sufficient as it.

[0037]

[Effect of the Invention] According to the X-ray generator of this invention, since adhesion of an inconvenient scattering particle and deposition (adhesion to the thin film for scattering particle inhibition, a clarification optical surface, etc., deposition) can be reduced about the direction of ejection of an X-ray consequently, long duration stability is carried out and an X-ray generator can be used.

[Translation done.]

DESCRIPTION OF DRAWINGS

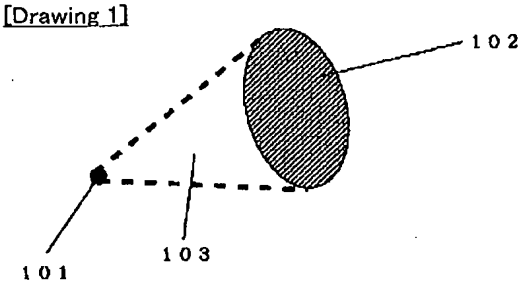
[Brief Description of the Drawings]
[Drawing 1] It is the perspective view (a) and outline sectional view (b) showing the field 103 within ** and the solid angle which expected opening 102 from the plasma 101 (solid angle field equivalent to the range which takes out an X-ray).
[Drawing 2] It is the perspective view (a) and outline sectional view (b) showing the field 105 within the solid angle which expected opening 102 from the plasma 101 at the time of forming ** and the scattering particle inhibition member 201 (solid angle field equivalent to the range which takes out an X-ray).
[Drawing 3] They are ** and the outline block diagram of the X-ray generator of an example.
[Drawing 4] It is the outline sectional view of the aperture 401 which is an example of ** and scattering particle control-section material.
[Drawing 5] It is the data Fig. showing the angular distribution of ** and scattering particle weight.
[Drawing 6] It is the outline block diagram of the X-ray generator of the example when using the scattering particle inhibition member 341 of ** and a truncated-cone configuration in the air.
[Drawing 7] It is the outline block diagram of the X-ray generator of the example when using the scattering particle inhibition member 351 which consists of ** and one plate.
[Drawing 8] It is the outline sectional view of the scattering particle inhibition member 811 which consists of two or more very thin plates established in ** and X linear-light on the street.
[Description of Notations in the Main Part]
101 ... Plasma
102 ... Opening
103,105 ... Field through which the X-ray to take out passes (solid angle field)
110,111,112,113 ... Locus of a scattering particle
201 ... Scattering particle inhibition member
303 ... Target member
304 ... Reel
311 ... YAG laser light (an example of an excitation energy beam)
312 ... Condenser lens
321 ... X-ray ejection filter (thin film for scattering particle inhibition)
330,341,351 ... Scattering particle inhibition member
331,332,333 ... Plate which has puncturing (member which constitutes the scattering particle inhibition member 330)
401 ... Tape presser-foot aperture (an example of scattering particle control-section material)
801 ... Plasma
802 ... X-ray ejection filter (thin film for scattering particle inhibition)
811 ... Scattering particle inhibition member
with -- Top

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

[Drawing 1]



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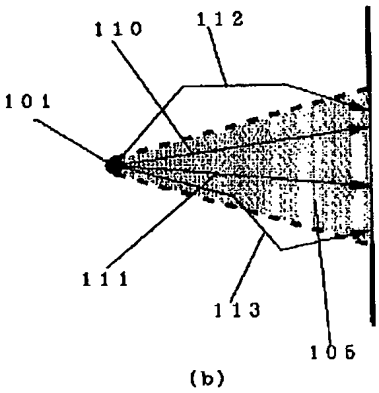
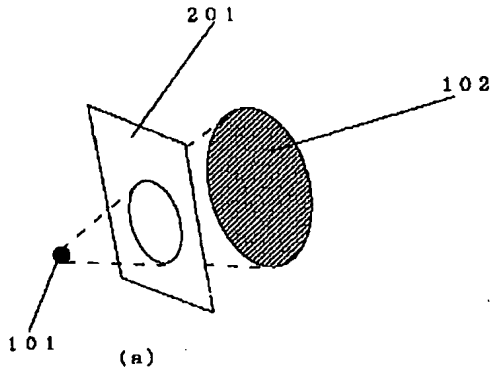


(b)

[Drawing 2]



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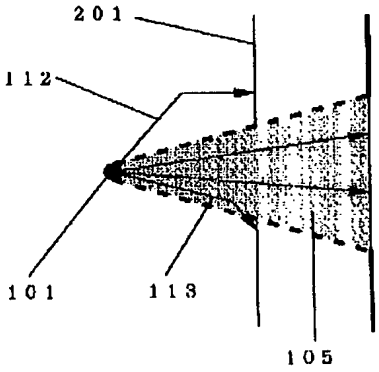
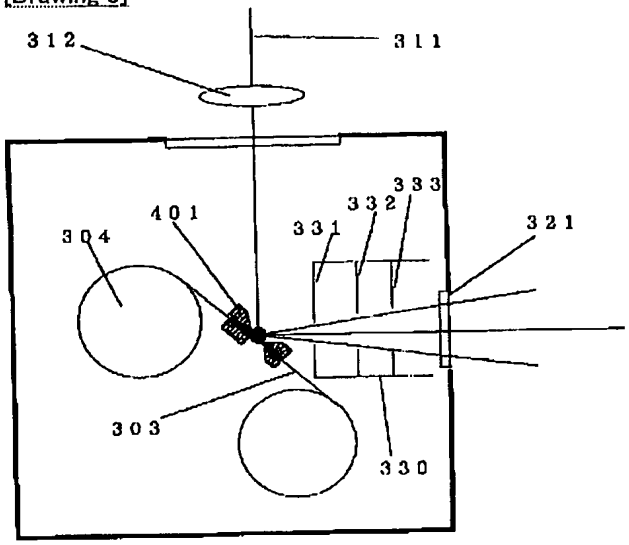
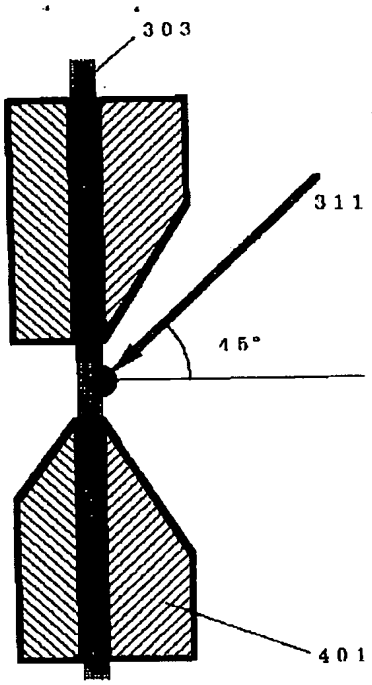


(b)

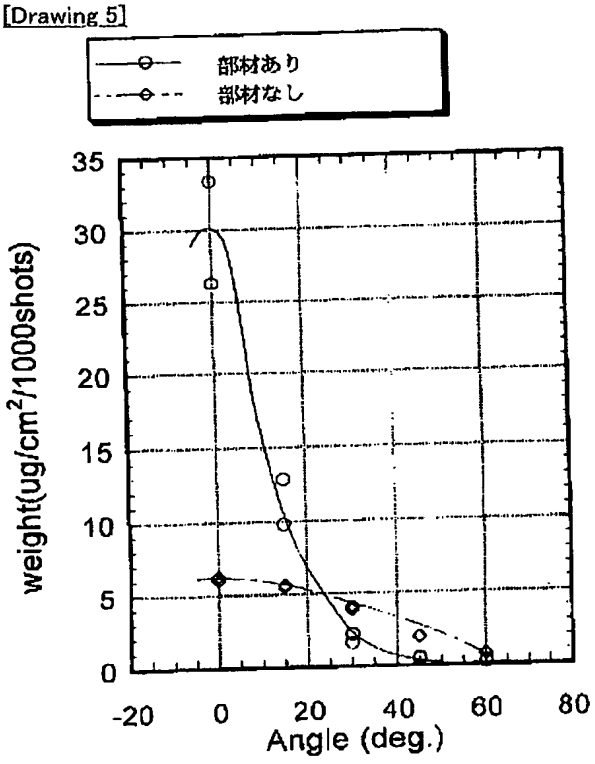
[Drawing 3]



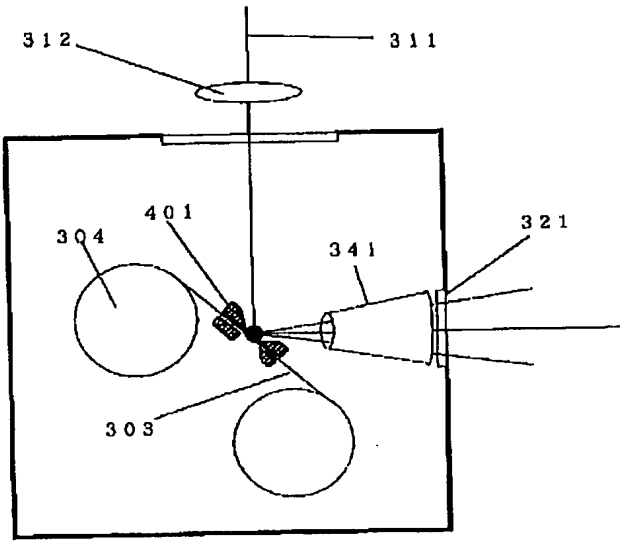
[Drawing 4]



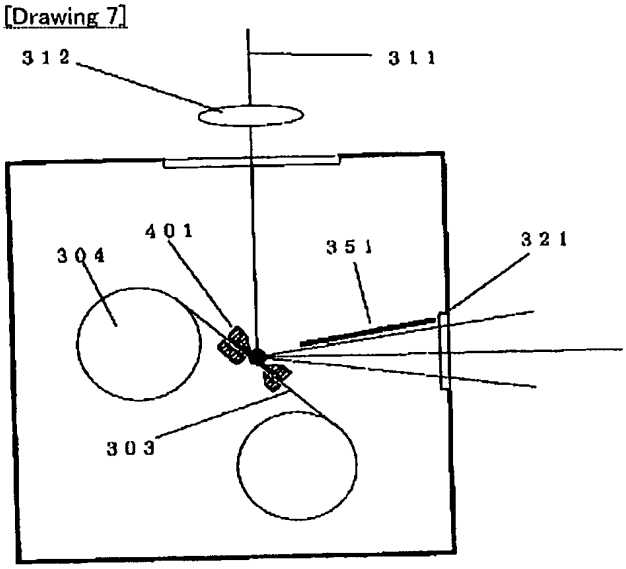
[Drawing 5]



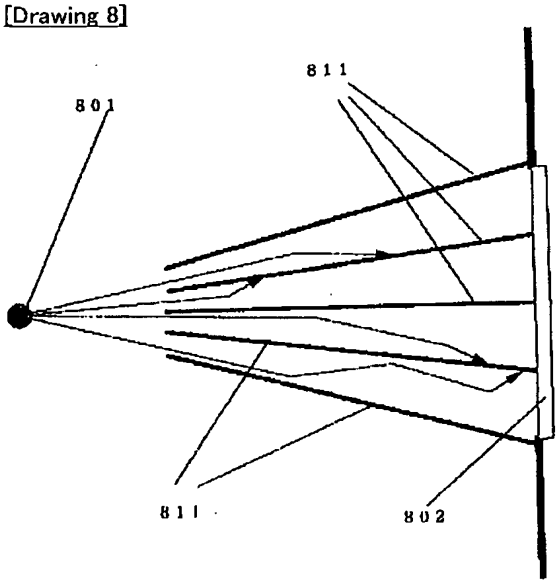
[Drawing 6]



[Drawing 7]



[Drawing 8]



[Translation done.]

CORRECTION OR AMENDMENT

[Kind of official gazette] Printing of amendment by the convention of 2 of Article 17 of Patent Law
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[Application number] Japanese Patent Application No. 7-127600
[The 7th edition of International Patent Classification]

H05G 2/00

[FI]

H05G 1/00 K

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[Filing Date] May 22, Heisei 14 (2002.5.22)
[Procedure amendment 1]
[Document to be Amended] Specification
[Item(s) to be Amended] The name of invention
[Method of Amendment] Modification
[Proposed Amendment]
[Title of the Invention] An X-ray generator and an X-ray aligner
[Procedure amendment 2]
[Document to be Amended] Specification
[Item(s) to be Amended] Claim
[Method of Amendment] Modification
[The contents of amendment]
[Claim(s)]
[Claim 1] The X-ray generator characterized by preparing the scattering particle inhibition member which adjoins or approaches in the solid angle field which is the X-ray generator which plasma-izes the target member in the decompressed vacuum housing, and takes out an X-ray from this plasma, and is equivalent to the range which takes out said X-ray in the X-ray generator which aims at inhibition of a scattering particle by using a buffer gas.
[Claim 2] The X-ray generator characterized by preparing a scattering particle inhibition member in the solid angle field which is the X-ray generator which plasma-izes the target member in the decompressed vacuum housing, and takes out an X-ray from this plasma, and is equivalent to the range which takes out said X-ray in the X-ray generator which aims at inhibition of a scattering particle by using a buffer gas.
[Claim 3] The scattering particle inhibition member prepared in said solid angle is an X-ray generator according to claim 2 characterized by consisting of sheet metal and being arranged in accordance with an optical path.
[Claim 4] An X-ray generator given in any 1 term of claims 1-3 characterized by having arranged said scattering particle inhibition member so that the thin film for scattering particle components or a clarification optical surface may be enclosed.
[Claim 5] It is the X-ray generator characterized by performing processing by which the front face of said scattering particle inhibition member tends to adsorb a scattering particle in an X-ray generator given in any 1 term of claims 1-4.
[Claim 6] An X-ray generator given in any 1 term of claims 1-5 characterized by establishing further a cooling means to cool said scattering particle inhibition member.
[Claim 7] An X-ray generator given in any 1 term of claims 1-6 characterized by preparing further the scattering particle control-section material which it is [material] the scattering particle control-section material which controls direction distribution of the burst size of said scattering particle emitted, and reduces the burst size of the scattering particle to the direction which takes out said X-ray.
[Claim 8] The X-ray generator according to claim 7 characterized by having the maximum open aperture section whose aperture angle over the minimum opening diameter and this minimum opening diameter said whose scattering particle control-section material is 0.1-3mm is 60 - 140 degrees.
[Claim 9] The X-ray generator according to claim 7 characterized by having the maximum gap section said whose scattering

particle control-section material is the gap of the shape of a taper which between at least two members comes to form, and whose aperture angle over the least interval section and this least interval section whose gap of the shape of this taper is 0.1-3mm is 60 - 140 degrees.

[Claim 10] The X-ray generator according to claim 7 to 9 characterized by using the tantalum, the tungsten, the diamond, or the ceramic as an ingredient used for said scattering particle control-section material.

[Claim 11] An X-ray generator given in any 1 term of claims 1-10 characterized by using a tantalum, aluminum, tin, zinc, or lead for said target ingredient.

[Claim 12] The X-ray aligner characterized by using an X-ray generator given in the optical system using Koehler illumination at any 1 term of claims 1-11.

[Translation done.]

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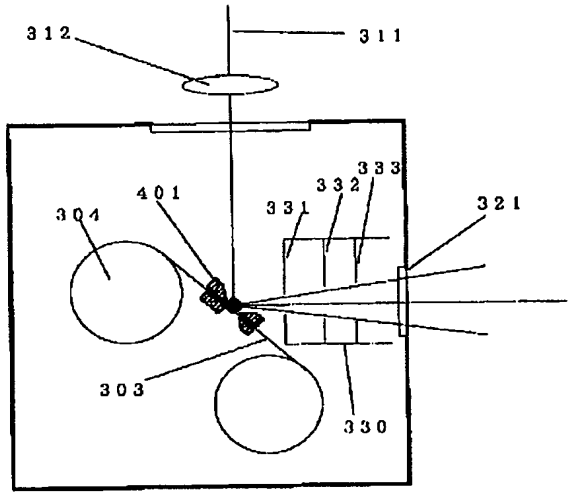
(71)出願人　000004112
株式会社ニコン
東京都千代田区丸の内３丁目２番３号
(72)発明者　神高　典明
東京都千代田区丸の内３丁目２番３号　株式会社ニコン内
(72)発明者　近藤　洋行
東京都千代田区丸の内３丁目２番３号　株式会社ニコン内

(54)【発明の名称】　Ｘ線発生装置

(57)【要約】
【目的】　Ｘ線の取り出し方向について、不都合な飛散粒子の付着、堆積を低減して、その結果、長時間安定して使用できるＸ線発生装置を提供すること。
【構成】　減圧された真空容器内の標的部材３０３に励起エネルギービーム３１１を照射してプラズマを形成させ、該プラズマからＸ線を取り出すＸ線発生装置であり、前記標的部材３０３及び／又は前記プラズマから放出される飛散粒子を阻止するためにバッファガスを用いるＸ線発生装置において、前記Ｘ線を取り出す範囲に相当する立体角領域に隣接または近接する飛散粒子阻止部材３３０を設けたことを特徴とするＸ線発生装置。



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【特許請求の範囲】

【請求項１】　減圧された真空容器内の標的部材に励起エネルギービームを照射してプラズマを形成させ、該プラズマからＸ線を取り出すＸ線発生装置であり、前記標的部材及び／又は前記プラズマから放出される飛散粒子を阻止するためにバッファガスを用いるＸ線発生装置において、

前記Ｘ線を取り出す範囲に相当する立体角領域に隣接または近接する飛散粒子阻止部材を設けたことを特徴とするＸ線発生装置。

【請求項２】　減圧された真空容器内の標的部材に励起エネルギービームを照射してプラズマを形成させ、該プラズマからＸ線を取り出すＸ線発生装置であり、前記標的部材及び／又は前記プラズマから放出される飛散粒子を阻止するためにバッファガスを用いるＸ線発生装置において、

前記Ｘ線を取り出す範囲に相当する立体角領域内に飛散粒子阻止部材を設けたことを特徴とするＸ線発生装置。

【請求項３】　前記標的部材及び／又は前記プラズマから放出される飛散粒子の放出量の方向分布を制御する飛散粒子制御部材であり、前記Ｘ線を取り出す方向への飛散粒子の放出量を低減させる飛散粒子制御部材をさらに設けたことを特徴とする請求項１または２記載のＸ線発生装置。

【請求項４】　前記飛散粒子阻止部材を冷却する冷却手段をさらに設けたことを特徴とする請求項１～３記載のＸ線発生装置。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、Ｘ線露光装置、Ｘ線顕微鏡、Ｘ線分析装置などのＸ線装置に用いられるＸ線発生装置に関するものである。

【０００２】

【従来の技術】レーザー光（励起エネルギービームの一例）を減圧された真空容器内に置かれた標的部材に集光して照射すると、標的部材は急速にプラズマ化し、このプラズマから非常に輝度の高いＸ線が幅射（放出）される（Ｘ線を発生する）ことが知られている（例えば、このようなＸ線発生源はＬＰＸ：Laser-Plasma X-raysource と呼ばれる）。

【０００３】Ｘ線の発生と共に、前記プラズマからは高速の電子やイオン等の飛散粒子が、また前記標的部材からは部材材料の飛散粒子（例えば、ガス化した材料、イオン化した材料、材料小片など）が放出されて真空容器内に飛散する（以下、これらをまとめて飛散粒子と呼ぶ）。これらの飛散粒子のうち、比較的形状の大きなものをデブリ（debris）と呼んでいる。このような飛散粒子（特に、デブリ）は、清浄光学面（例えば、Ｘ線光学素子面）に衝突して、これらを破損したり、或いは付着、堆積して機能や特性を低下させたり変化させるので、大きな問題であった。

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【０００４】この問題点を解決するために従来の方法では、Ｘ線源と清浄光学面との間に、Ｘ線透過性の高い物質（例えば、Ｂｅ）からなる薄膜（以下、飛散粒子阻止用薄膜またはＸ線取り出しフィルターと呼ぶ）を設置して遮蔽することにより、飛散粒子が清浄光学面に到達しないようにしていた。その他の方法としては、真空容器内にＸ線に対する透過率の高い低原子番号のガス（例えば、Ｈｅガス）を充填することにより、或いは該ガスのガス流を形成することにより、飛散粒子にガス分子を衝突させて飛散粒子の阻止を図っていた（特開昭63-292553 参照）。

【０００５】

【発明が解決しようとする課題】飛散粒子阻止用薄膜の設置により、清浄光学面への飛散粒子の付着、堆積は防げるが、そのかわり、飛散粒子阻止用薄膜上に飛散粒子が付着、堆積するので、飛散粒子阻止用薄膜のＸ線透過率が次第に低下する（Ｘ線取り出し方向における使用Ｘ線強度が低下する）という問題点がある。

【０００６】また、真空容器内にＸ線に対する透過率の高い低原子番号のガス（バッファガス）を充填することにより、或いは該ガスのガス流を形成することにより、飛散粒子の阻止を図る方法では、必ずしも飛散粒子を有効に阻止できるわけではないという問題点がある。例えば、標的部材がタンタルである場合に、十分に排気された（圧力１０Ｐａ以下）真空容器内では、飛散粒子は標的部材表面の法線方向に多く分布する。そして、真空容器内に飛散粒子阻止用のバッファガスを導入すると、飛散粒子が多く放出される方向については、ガス分子による散乱のために飛散粒子は減少するが、散乱した飛散粒子はガス導入前には飛散粒子の放出が少なかった方向にも飛散する。

【０００７】そのため、飛散粒子を阻止するためにバッファガスを使用すると、飛散粒子の放出方向の分布が均一化される。このことは、飛散粒子の放出が少ない方向については、飛散粒子の放出が多い方向と比較してガス導入の効果が小さいか、むしろ逆効果となることを示している。Ｘ線の取り出しは、飛散粒子の放出が少ない方向において行うのが一般的であり、飛散粒子の放出が少ないＸ線の取り出し方向について、ガス導入の効果が小さいか、むしろ逆効果となることは大きな問題点である。

【０００８】特に、プラズマ近傍に飛散粒子の放出量の方向分布を制御する飛散粒子制御部材であり、前記Ｘ線を取り出す方向への飛散粒子の放出量を低減させる飛散粒子制御部材を設ける場合に、Ｘ線の取り出し方向について、ガス導入の効果が小さいか、むしろ逆効果となることは大きな問題点である。本発明は、かかる問題点に鑑みてなされたもので、飛散粒子を阻止するためにバッファガスを用いるＸ線発生装置であり、Ｘ線の取り出し

方向について、不都合な飛散粒子の付着、堆積を低減して、その結果、長時間安定して使用できるＸ線発生装置を提供することを目的とする。

【０００９】

【課題を解決する為の手段】そのため、本発明は第一に「減圧された真空容器内の標的部材に励起エネルギービームを照射してプラズマを形成させ、該プラズマからＸ線を取り出すＸ線発生装置であり、前記標的部材及び／又は前記プラズマから放出される飛散粒子を阻止するためにバッファガスを用いるＸ線発生装置において、前記Ｘ線を取り出す範囲に相当する立体角領域に隣接または近接する飛散粒子阻止部材を設けたことを特徴とするＸ線発生装置（請求項１）」を提供する。

【００１０】また、本発明は第二に「減圧された真空容器内の標的部材に励起エネルギービームを照射してプラズマを形成させ、該プラズマからＸ線を取り出すＸ線発生装置であり、前記標的部材及び／又は前記プラズマから放出される飛散粒子を阻止するためにバッファガスを用いるＸ線発生装置において、前記Ｘ線を取り出す範囲に相当する立体角領域内に飛散粒子阻止部材を設けたことを特徴とするＸ線発生装置（請求項２）」を提供する。

【００１１】また、本発明は第三に「前記標的部材及び／又は前記プラズマから放出される飛散粒子の放出量の方向分布を制御する飛散粒子制御部材であり、前記Ｘ線を取り出す方向への飛散粒子の放出量を低減させる飛散粒子制御部材をさらに設けたことを特徴とする請求項１または２記載のＸ線発生装置（請求項３）」を提供する。

【００１２】また、本発明は第四に「前記飛散粒子阻止部材を冷却する冷却手段をさらに設けたことを特徴とする請求項１～３記載のＸ線発生装置（請求項４）」を提供する。

【００１３】

【作用】減圧された真空容器内の標的部材に励起エネルギービームを照射してプラズマを形成させ、該プラズマからＸ線を取り出すＸ線発生装置であり、前記標的部材及び／又は前記プラズマから放出される飛散粒子を阻止するためにバッファガスを用いるＸ線発生装置に、Ｘ線を取り出す範囲に相当する立体角領域の外側（隣接または近接する領域）または内側に位置する飛散粒子阻止部材を設けると、Ｘ線の取り出し方向について、不都合な飛散粒子の付着、堆積（飛散粒子阻止用薄膜や清浄光学面などへの付着、堆積）を低減できるので、その結果、長時間安定してＸ線発生装置を使用できる（請求項１、２）。

【００１４】図１（ａ）のように、プラズマ１０１から開口１０２を見込んだ立体角内の領域（Ｘ線を取り出す範囲に相当する立体角領域）１０３を考える。図１（ｂ）はプラズマ及び開口を含む断面を示す。十分な真空状態では、飛散粒子は直線的に運動し、立体角領域１０３（１０５）内に出射した飛散粒子１１０、１１１は、領域１０３（１０５）内のみを通って開口１０２に到達する。

【００１５】しかし、真空容器内にバッファガスを導入すると、飛散粒子はガス分子と衝突して散乱されるので、最初は領域１０３（１０５）の外に出射した飛散粒子の中には、散乱の結果、領域１０３（１０５）内に進入してくる粒子１１２が、また一度領域１０３（１０５）の外に出た飛散粒子の中には、再び領域１０３（１０５）内に戻る粒子１１３が、それぞれ存在する。

【００１６】このことは、開口１０２に到達する飛散粒子は、発生してから到達するまで、終始、領域１０３（１０５）内を通過するとは限らないことを示す。これに対して、プラズマから発生したＸ線の光路は直線であり、開口１０２に到達するＸ線の光は常に領域１０３（１０５）内にある。ここで、例えば図２に示すように、開孔付きの部材２０１（飛散粒子阻止部材の一例）を設けた場合を考える。部材の開孔は、立体角領域１０３（１０５）の切断面に等しい。

【００１７】部材２０１を設けても開口１０２に達するＸ線には、なんら影響がなく、取り出されるＸ線の量は変化しない。これに対して、飛散粒子のうち、領域１０３（１０５）内に進入しようとする前記粒子１１２、１１３は、部材２０１により阻止されるので、部材２０１を設けないときに比べて、開口１０２に達する飛散粒子は減少する。

【００１８】このような効果をもたらす飛散粒子阻止部材は、領域１０３（１０５）の外に出た飛散粒子が再度領域１０３（１０５）内に進入するのを阻止できる形状を有すればよく、部材２０１のような開孔付きの板状の物に限定されるわけではない。また、厳密には取り出すＸ線光量が低下することになるが、Ｘ線を取り出す範囲に相当する立体角領域内に飛散粒子阻止部材を設けても、前記の効果が得られる。例えば、図８に示すように、立体角領域内にあるＸ線の光路上に非常に薄い板を光路に沿って設ける場合である。

【００１９】このように、減圧された真空容器内の標的部材に励起エネルギービームを照射してプラズマを形成させ、該プラズマからＸ線を取り出すＸ線発生装置であり、前記標的部材及び／又は前記プラズマから放出される飛散粒子を阻止するためにバッファガスを用いるＸ線発生装置に、Ｘ線を取り出す範囲に相当する立体角領域の外側（隣接または近接する領域）または内側に位置する飛散粒子阻止部材を設けると、Ｘ線の取り出し方向について、不都合な飛散粒子の付着、堆積（飛散粒子阻止用薄膜や清浄光学面などへの付着、堆積）を低減できるので、その結果、長時間安定してＸ線発生装置を使用できる（請求項１、２）。

【００２０】また、飛散粒子の放出量の方向分布を制御

する飛散粒子制御部材であり、Ｘ線を取り出す方向への飛散粒子の放出量を低減させる飛散粒子制御部材をさらに設けると、Ｘ線の取り出し方向における飛散粒子阻止効果が増大するので好ましい（請求項３）。かかる飛散粒子制御部材により、Ｘ線取り出し方向への飛散粒子放出量を低減させるためには、例えば、飛散粒子制御部材に以下のような形状部分を設けるとよい。

【００２１】かかる形状部分としては、例えば、前記飛散粒子制御部材に設けられた貫通孔であって、0.１～３ｍｍの最小開口径部と該最小開口径部に対する開き角が６０～１４０度である最大開口径部を有する貫通孔が好ましい。前記最小開口径部を前記励起エネルギービームの前記標的部材上への集光部分に隣接又は近接させ、前記励起エネルギービームが前記貫通孔を通って前記集光部分に入射する角度を０～６０度に、また該集光部分に対する前記Ｘ線の取り出し角を３０～６０度にそれぞれ設定すると、取り出し方向へのＸ線強度を減少させることなく、取り出し方向への不都合な飛散粒子の付着、堆積を著しく低減できるので好ましい。

【００２２】Ｘ線を取り出す方向への飛散粒子放出量を低減させる形状部分は、飛散粒子制御部材に設けた前記貫通孔に限らず、例えば、飛散粒子制御部材が複数の部材により構成されている場合には、該複数の部材のうちの少なくとも二つの部材の間に形成されてなるテーパ状の間隙であって、0.１～３ｍｍの最小間隙部と、該最小間隙部に対する開き角が６０～１４０度である最大間隙部を有するテーパ状の間隙でもよい。

【００２３】かかるテーパ状の間隙の最小間隙部を励起エネルギービームの標的部材上への集光部分に隣接又は近接させ、かつ、励起エネルギービームがテーパ状の間隙を通って前記集光部分に入射する角度を０～６０度に、また該集光部分に対するＸ線の取り出し角を３０～６０度にそれぞれ設定すると、取り出し方向へのＸ線強度を低減することなく、不都合な飛散粒子の付着、堆積を低減することができるので好ましい。

【００２４】本発明にかかる飛散粒子制御部材に用いる材料としては、例えば、タンタル、タングステン、ダイヤモンド、セラミックなどの高融点、又は高硬度の材料が好ましい。これは、飛散粒子制御部材がプラズマに非常に近接した位置に配置されるので、プラズマから飛来するイオンや電子の該部材表面への衝突による該部材材料の放出を防止するためである。即ち、該部材材料の放出があると飛散粒子と同様に不都合な付着、堆積が生じるので、これを防止するのである。

【００２５】前記飛散粒子阻止部材を冷却する冷却手段をさらに設けると、該部材が飛散粒子を吸着しやすくなって、阻止効果が増大するので好ましい（請求項４）。或いは、飛散粒子を吸着しやすいように、飛散粒子阻止部材の表面を加工（例えば、つや消し加工）することも好ましい。以下、本発明を実施例により更に詳細に説明するが、本発明はこれらの実施例に限定されるものではない。

【００２６】

【実施例】図３に本実施例のＸ線発生装置の概略構成図を示す。また、図４は飛散粒子放出量の方向分布を制御する飛散粒子制御部材であり、Ｘ線を取り出す方向への飛散粒子の放出量を低減させる飛散粒子制御部材の一例であるテープ押さえアパーチャー４０１の拡大断面図である。

【００２７】飛散粒子の放出量の角度分布は、このアパーチャー４０１により制御されて、タンタルテープ表面の法線方向に集中した分布となる。アパーチャー４０１がある場合とない場合の飛散粒子放出量の角度分布を図５に示す。ＹＡＧレーザー光（励起エネルギービームの一例）３１１が集光レンズ３１２によりＴａターゲット（標的部材の一例）３０３の表面に集光される。Ｔａターゲット３０３は、厚さ１５μｍのテープ形状であり、テープ上の同位置にレーザー光が集光されることがないように、プラズマ発生時には、駆動手段（例えば、モーター、不図示）によりリール３０４を回転させてＴａテープを巻き取りながら、レーザー集光位置を変化させている。

【００２８】Ｔａテープの移動速度は、一つのプラズマが生成されて次のプラズマを生成するレーザー光が入射するまでに、プラズマの発生によりＴａテープに生じる孔の直径分以上に移動する速度である。発生したプラズマから放射（輻射）されるＸ線は、Ｘ線取り出しフィルタ（飛散粒子阻止用薄膜）３２１を通過してＸ線光学系に至る。

【００２９】本実施例では、飛散粒子阻止部材３３０は図３に示すように、フィルタ３２１に入射するＸ線の光路を遮らないような開孔を有する３枚の板３３１、３３２、３３３を有し、各板は所定の距離にてそれぞれ隔離されている。また、真空容器内には、バッファガスとしてヘリウムが導入されており、またその圧力を一定に保持するように、ヘリウムの導入及び排気を行っている。

【００３０】Ｔａターゲット３０３は、非常に高い融点を有するので、発生する飛散粒子はイオン、原子レベルの大きさである。飛散粒子放出量の角度分布は、図５に示す通りであり、本実施例では、Ｘ線取り出し方向における飛散粒子放出量が少なくなるように、Ｘ線の取り出し角度を４５°としている。プラズマから板３３１までの距離は短いので、飛散粒子はバッファガスの影響を殆ど受けることなく板３３１に到達する。即ち、最初にＸ線取り出し方向に飛びだした飛散粒子以外は、板３３１により殆ど阻止される。

【００３１】図５に示すように、飛散粒子の放出はタンタルテープ表面の法線方向に集中するが、この方向の飛散粒子も板３３１により阻止されるので、バッファガスにより散乱しても、フィルタ３２１に到達することはな

い。また、板３３１の開孔を通過した飛散粒子は、バッファガスにより散乱しながら進むので、その軌跡は直線ではなくなり、フィルタ３２１に向かうにつれて、最初の進行方向からずれていく。

【００３２】そのため、板３３１の開孔を通過した飛散粒子でも、板３３２または板３３３の開孔を通過できないものがでてくる。従って、最終的にフィルタ３２１に到達する飛散粒子は、Ｘ線を取り出す範囲に相当する立体角領域において最初に発生する飛散粒子よりもかなり減少する。飛散粒子阻止部材３３０の形状は、図３の例に限定されるものではなく、Ｘ線取り出し方向に放射されたＸ線の光路を遮ることなく、飛散粒子を効率よく阻止できるものであればよい。

【００３３】例えば、図６に示すような中空の円錐台形状の飛散粒子阻止部材３４１としてもよい。或いは、飛散粒子阻止部材の微妙な位置合わせが困難である場合には、図７に示すように、１枚の板からなる飛散粒子阻止部材３５１としてもよく、この場合でも、飛散粒子が多い方向から散乱によってＸ線取り出し方向に向かってくる飛散粒子を飛散粒子阻止部材３５１により有効に阻止できる。

【００３４】また、Ｘ線を取り出す範囲に相当する立体角領域内にあるＸ線の光路を多少は遮ることになるが、図８に示すように、Ｘ線光路上に非常に薄い複数の板からなる飛散粒子阻止部材８１１を光路に沿って設置することも有効である。この場合、飛散粒子が立体角領域から出ないときでも、バッファガスによりその進行方向が少しでも変われば、飛散粒子阻止部材８１１に吸着される。

【００３５】図８に示す飛散粒子阻止部材８１１を用いた場合に、クリティカル照明を行うと、照明ムラが発生するが、ケーラー照明を行うときやＸ線の総光量のみを対象とするとき（例えば、分析機器など）には、ごく僅かにＸ線量が低下するだけであり、実用上は問題がない。飛散粒子阻止部材３３０、３４１、３５１、８１１は、飛散粒子を吸着しやすいように、表面を加工（例えば、つや消し加工）することが好ましい。また、飛散粒子阻止部材３３０、３４１、３５１、８１１を冷却する冷却手段をさらに設けると、該部材が飛散粒子を吸着しやすくなって、阻止効果が増大するので好ましい。

【００３６】なお、標的部材の形状はテープ状に限定されるものではなく、例えば、板状やバルク状であってもよい。また、標的部材の材料もＴａに限定されるものではなく、Ａｌ，Ｓｎ，Ｚｎ，Ｐｂなどでもよい。

【００３７】

【発明の効果】本発明のＸ線発生装置によれば、Ｘ線の取り出し方向について、不都合な飛散粒子の付着、堆積（飛散粒子阻止用薄膜や清浄光学面などへの付着、堆積）を低減できるので、その結果、長時間安定してＸ線発生装置を使用できる。

【図面の簡単な説明】

【図１】は、プラズマ１０１から開口１０２を見込んだ立体角内の領域（Ｘ線を取り出す範囲に相当する立体角領域）１０３を示す斜視図（ａ）と概略断面図（ｂ）である。

【図２】は、飛散粒子阻止部材２０１を設けた場合における、プラズマ１０１から開口１０２を見込んだ立体角内の領域（Ｘ線を取り出す範囲に相当する立体角領域）１０５を示す斜視図（ａ）と概略断面図（ｂ）である。

【図３】は、実施例のＸ線発生装置の概略構成図である。

【図４】は、飛散粒子制御部材の一例であるアパーチャー４０１の概略断面図である。

【図５】は、飛散粒子量の角度分布を示すデータ図である。

【図６】は、中空の円錐台形状の飛散粒子阻止部材３４１を用いたときの実施例のＸ線発生装置の概略構成図である。

【図７】は、１枚の板からなる飛散粒子阻止部材３５１を用いたときの実施例のＸ線発生装置の概略構成図である。

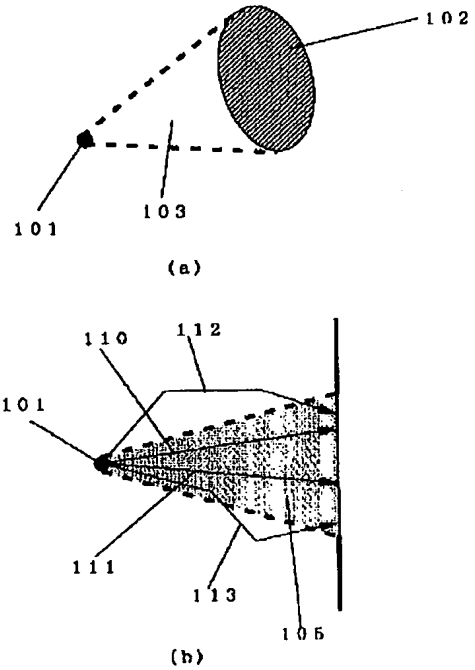
【図８】は、Ｘ線光路上に設けた、非常に薄い複数の板からなる飛散粒子阻止部材８１１の概略断面図である。

【主要部分の符号の説明】

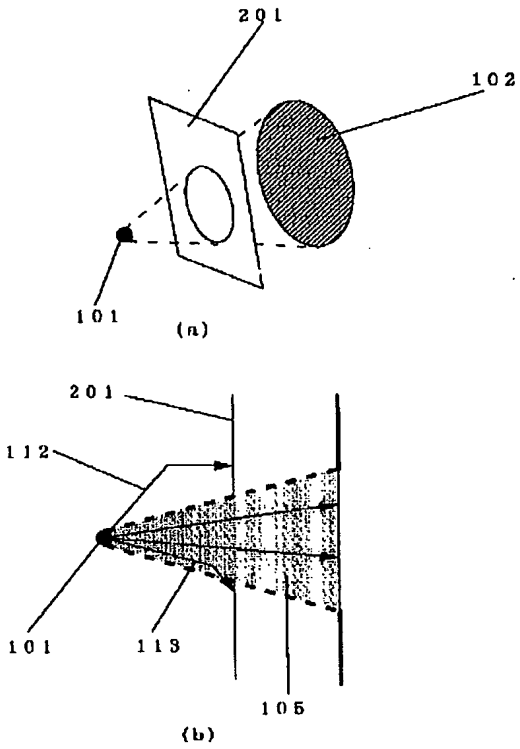
１０１・・・プラズマ
１０２・・・開口
１０３，１０５・・・取り出すＸ線が通過する領域（立体角領域）
１１０，１１１，１１２，１１３・・・飛散粒子の軌跡
２０１・・・飛散粒子阻止部材
３０３・・・標的部材
３０４・・・リール
３１１・・・ＹＡＧレーザー光（励起エネルギービームの一例）
３１２・・・集光レンズ
３２１・・・Ｘ線取り出しフィルター（飛散粒子阻止用薄膜）
３３０，３４１，３５１・・・飛散粒子阻止部材
３３１，３３２，３３３・・・開孔を有する板材（飛散粒子阻止部材３３０を構成する部材）
４０１・・・テープ押さえアパーチャー（飛散粒子制御部材の一例）
８０１・・・プラズマ
８０２・・・Ｘ線取り出しフィルター（飛散粒子阻止用薄膜）
８１１・・・飛散粒子阻止部材

以　上

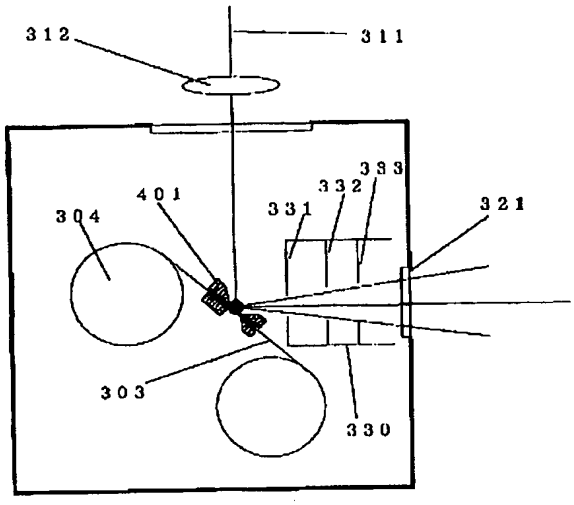
【図1】


102
101
103
(a)
110
112
101
111
113
105
(b)

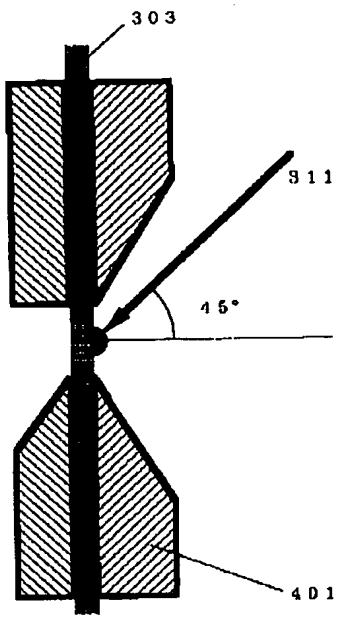
【図2】


201
102
101
(a)
201
112
101
113
105
(b)

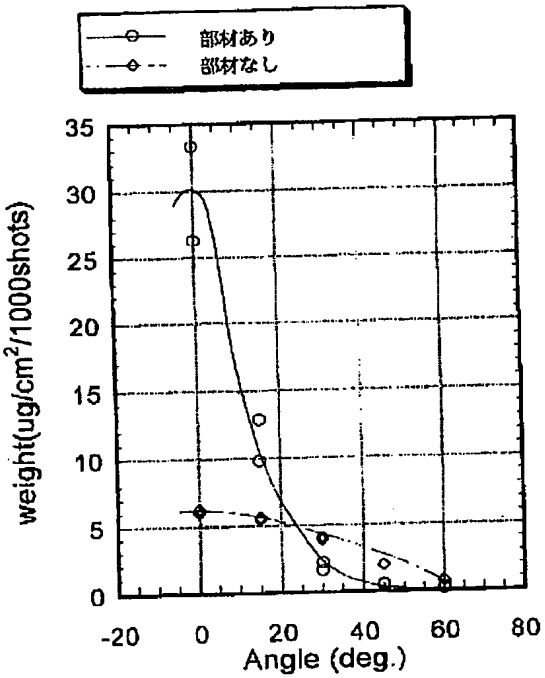
【図3】


312
311
304
401
331
332
333
321
303
330

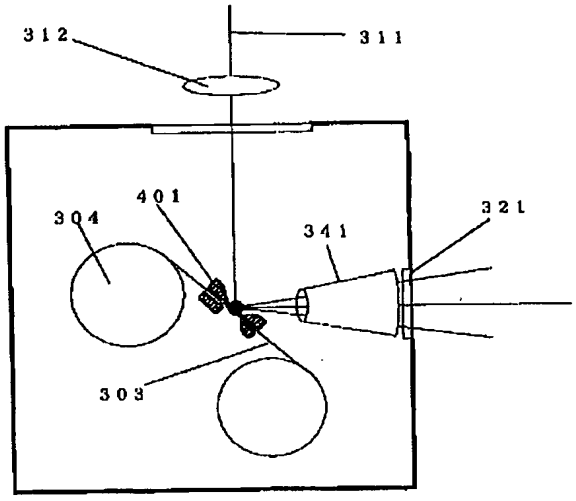
【図4】


303
311
45°
401

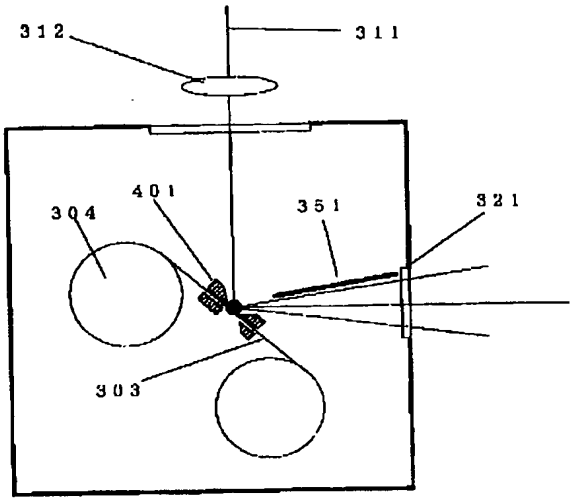
【図５】


部材あり
部材なし
weight(ug/cm²/1000shots)
35
30
25
20
15
10
5
0
-20
0
20
40
60
80
Angle (deg.)

【図６】


312
311
304
401
341
321
303

【図７】


312
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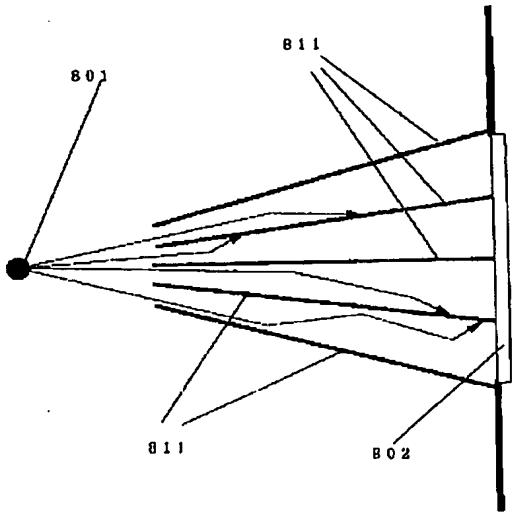
401
351
321
303

【図８】


811
801
811
802

【公報種別】特許法第１７条の２の規定による補正の掲載
【部門区分】第７部門第１区分
【発行日】平成１４年８月３０日（２００２．８．３０）

【公開番号】特開平８－３２１３９５
【公開日】平成８年１２月３日（１９９６．１２．３）
【年通号数】公開特許公報８－３２１４
【出願番号】特願平７－１２７６００
【国際特許分類第７版】
H05G　2/00
【ＦＩ】
H05G　1/00　　K

【手続補正書】
【提出日】平成１４年５月２２日（２００２．５．２２）
【手続補正１】
【補正対象書類名】明細書
【補正対象項目名】発明の名称
【補正方法】変更
【補正内容】
【発明の名称】　　Ｘ線発生装置及びＸ線露光装置
【手続き補正２】
【補正対象書類名】明細書
【補正対象項目名】特許請求の範囲
【補正方法】変更
【補正の内容】
【特許請求の範囲】
【請求項１】　減圧された真空容器内の標的部材をプラズマ化し、該プラズマからＸ線を取り出すＸ線発生装置であり、バッファガスを用いることにより飛散粒子の阻止を図るＸ線発生装置において、前記Ｘ線を取り出す範囲に相当する立体角領域に隣接または近接する飛散粒子阻止部材を設けたことを特徴とするＸ線発生装置。
【請求項２】　減圧された真空容器内の標的部材をプラズマ化し、該プラズマからＸ線を取り出すＸ線発生装置であり、バッファガスを用いることにより飛散粒子の阻止を図るＸ線発生装置において、前記Ｘ線を取り出す範囲に相当する立体角領域内に飛散粒子阻止部材を設けたことを特徴とするＸ線発生装置。
【請求項３】前記立体角内に設けた飛散粒子阻止部材は薄板から構成され、光路に沿って配置されることを特徴とする請求項２に記載のＸ線発生装置。
【請求項４】前記飛散粒子阻止部材を飛散粒子素子用薄膜または清浄光学面を囲うように配置したことを特徴とする、請求項１～３のいずれか1項に記載のＸ線発生装置。
【請求項５】請求項１から４のいずれか1項に記載のＸ線発生装置において、前記飛散粒子阻止部材の表面は飛散粒子を吸着しやすい加工が施されていることを特徴とするＸ線発生装置。
【請求項６】　前記飛散粒子阻止部材を冷却する冷却手段をさらに設けたことを特徴とする請求項１～5のいずれか1項に記載のＸ線発生装置。
【請求項７】　前記放出される飛散粒子の放出量の方向分布を制御する飛散粒子制御部材であり、前記Ｘ線を取り出す方向への飛散粒子の放出量を低減させる飛散粒子制御部材をさらに設けたことを特徴とする請求項１～６のいずれか1項に記載のＸ線発生装置。
【請求項８】前記飛散粒子制御部材が0.1～3ｍｍの最小開口径部と該最小開口径部に対する開き角が６０～１４０度である最大開口径部を有する事を特徴とする請求項７に記載のＸ線発生装置。
【請求項９】前記飛散粒子制御部材が、少なくとも２つの部材の間によって形成されてなるテーパー状の間隙であり、該テーパー状の間隙が0.1～3ｍｍの最小間隙部と該最小間隙部に対する開き角が６０～１４０度である最大間隙部を有する事を特徴とする請求項７に記載のＸ線発生装置。
【請求項１０】前記飛散粒子制御部材に用いる材料としてタンタル、タングステン、ダイヤモンド、セラミックのいずれかが用いられていることを特徴とする請求項７～９に記載のＸ線発生装置。
【請求項１１】前記標的材料に、タンタル、アルミニウム、錫、亜鉛、鉛のいずれかを用いることを特徴とする請求項１～１０のいずれか1項に記載のＸ線発生装置。
【請求項１２】ケーラー照明を用いる光学系に請求項１～１１のいずれか１項に記載のＸ線発生装置を用いた事を特徴とするＸ線露光装置。